50X1-HUM

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DESCRIPTION AND OPERATING INSTRUCTIONS FOR A PULSE POWER METER TYPE LM5 - 1, RANGE 12 - 80 cm

This pulse meter serves for the measurement of high-frequency pulse powers between 0 and 10 kW, and between 0 and 100 kW at pulse widths down to 0.4 microseconds and pulse frequencies down to 50 cps.

Mode of operation: The maximum value of the high-frequency voltage across a resistor of 50-ohms of special construction (laminated resistance on a porcelain body in an exponential tube) in the stated frequency range is indicated, by means of a diode and an inverse vacuum-tube voltmeter, on a microammeter.

Specifications:

Frequency range	375 mc - 2500 mc
Wavelength	12 cm - 80 cm
Pulse power measuring range I:	0 - 100 kW
Pulse power measuring range II:	0 - 10 kW
Maximum thermal energy generated	200 W
Input resistance	50 ohms ± 2%
Operating voltage	110 V, 127 V, 220V, at 50 cps ± 10%
Dimensions:	Height 230 mm, width 665 mm, depth 250 mm
Weight	24.5 kg

Description:

The high frequency is applied to the 50-ohm terminal resistor of the apparatus through a high-frequency line of 50-ohm impedance. The terminal resistor is of special design (tube in exponential form) and terminates the line free of reflection. By measurement of the peak HF voltage U_{sp} on the absorption resistance R, the effective HF pulse power can be determined from the formula:

$$N = \frac{U_{sp}^2}{2R} = \frac{U_{sp}^2}{100}$$

The voltage is indicated by a type SA 102 diode in a C-circuit (peak rectification) with an inverse vacuum-tube voltmeter substituting for

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an electrostatic indicating device. At higher powers, the HF peak voltage at the terminals of the-60 ohm absorption resistor would be several thousand volts, so that the diode would be badly overloaded. Thus, the measuring voltage is picked off the resistor, reduced in a 1:10 ratio. Then, with a peak power of 100 kW, the HF peak voltage on the diode would be

$$U_{sp} = 1/10 \sqrt{2NR} = 1/10 \sqrt{10^7} = 316 \text{ V},$$

while, with a peak power of 10 kW, the HF peak voltage on the diode would be

$$U_{sp} = 1/10 \sqrt{2NR} = 1/10 \sqrt{10^6} = 100 \text{ V}.$$

The current, rectified by the diode, now charges a condenser in series with the diode to the peak value of the HF voltage. The ~~anode~~ plate - cathode circuit of ~~the~~ a 6 Zh 7-type (6J7) tube is in parallel with this condenser in such a manner that the ~~anode~~ plate will be negative with respect to the cathode, if there is any charging voltage present. The grid current is now controlled through the gain of the tube. The gain becomes smaller as the ~~anode~~ plate becomes more negative, i.e. when the HF peak voltage increases.

In order to avoid an inverse indication, the grid-cathode circuit of the triode is connected into one of the four sides of a bridge circuit. The indicating instrument, an ammeter with a maximum indication of 100 microamps, is inserted in the diagonal of this bridge. An increasing indication will thus correspond to increasing power. The supplied HF power "N" was plotted in calibration curves and these curves were entered on the scale of the instrument, so that direct readings in kW are possible.

In the range of small negative ~~anode~~ plate voltages on the inverse vacuum-tube voltmeter there is danger of setting up short Barkhausen oscillations. However, by very careful design of the apparatus it has been possible to suppress them to such an extent that they will never occur at ~~anode~~ plate voltages which correspond to the smallest measuring lines of practical interest. The peculiar circuit of the inverse vacuum-tube voltmeter requires the grounding of the ~~anode~~ plate of the indicator tube. Thus, the entire measuring device including the voltage sources is at a few hundred volts DC above ground potential. These comparatively high voltages require a very high degree of insulation to avoid fluctuations due to surface leakage and other causes. This is accomplished by especially careful construction and by a specially designed supply transformer. The insulation or leakage resistance of the circuit was approximately 10^{10} ohms as determined from the decrease, with time, of the charge of the condenser to the e-th part. The condenser was dimensioned in such a way that the discharge time constant T_e has the order of magnitude of a few seconds.

With this condenser and with a mean insulation resistance of the triode of approximately 1000 ohms the charging time constant T_e is only a few microseconds. This guarantees that the peak voltage rectification will be maintained at approximately 99 percent, even under the most unfavorable conditions, i.e. low pulse frequency and duration, while transmitter output fluctuations will still be registered with sufficient speed.

Operating instructions:

The operation of the pulse power meter for HF pulses is best carried out in the following order:

1) Set the voltage selector Sch 2 to the line voltage of 110, 127 or 220 V.

2) Connect the power meter to the HF generator to be tested by means of a 50-ohm cable.

3) Ground the set by means of the ground jack provided for this purpose.

4) Main switch Sch 1 is then brought to position "Anlauf" (Warm-up). The switch is left in this position for about half a minute to allow the tubes to reach their normal filament temperature. As long as this temperature has not been reached, the bridge of the inverse vacuum-tube voltmeter will not be balanced and turning switch

1 to the next setting would damage the instrument.

5) After half a minute, the switch may be moved to one of the next positions for 100 KW or 10 KW.

6) Adjusting the bridge to full compensation, i.e. to a zero deflection of the indicating instrument. This is carried out by careful turning of the knob marked "Compensation" on the front panel.

7) The set is now ready for operation. The peak voltage can be read off the dial directly after the generator has been turned on.

END

Appendix:

(84367-1) — General View of Apparatus.
~~Fig. 1. Frontispiece - no legend~~
(84367-2) — Front and Side Views
~~Figure 2 Circuit diagram~~
(84367-7) — Front View
(84367-8) — Circuit diagram

Schalter - switch
Stellung - position

Alle schraffierten.... - all shaded areas denote "Off" positions

Alle 3 Schalter ... all three switches are operated by a common shaft

Sockelanschlüsse ... Base connections viewed from below the tubes ~~toward the tubes~~ kleiner Swansockel - small "Swan" (?) base

(84367-9)-Parts List

Symbol	Item	On drawing No.	Item No.	Electrical data and remarks
	Plug			two poles
	Jack			one pole
	Jack	assembly according to drwg. No. C 132-03		
	Paper condenser			
	Paper condenser			
	omitted			
	Condenser	assembly according to drwg. No. E 132 U 6		40 mmfd. each
	Condenser			
	Condenser			

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(Parts list continued:)

Item	on dwg no.	Item No.	Electrical Data and Remarks
Glow lamp			
Base for glow lamp			
Rotary coil instrument			
Three-phase motor			
Tube			
Base for tube 1	small "Swan" base		
Tube	6 Zh 7		
Base for tube 2	octal base (ceramic)		
Tube			
Base for tube 3	assembly according to drwg. E 132 U 6		
Switch			made according to SK 45
Cutoff switch	assembly according to drwg. E 132 U 4		
Selector switch	Assembly according to drwg. E 132 U 32		four poles
Selector switch			four poles
Precision fuse			in switch 1
Transformer			
Transformer ~~Laminar resistor~~			
(84367-10) Laminar resistor			
Laminar resistor			
Rotary laminar resistor			
Laminar resistor			
Rotary laminar resistor			
Laminar resistor			
Laminary resistor			
Rotary laminar resistor			
Laminar resistor			
Resistor	according to drwg. E 152-81		
Laminar resistor			
Ultrahigh-ohmic resistor	according to drwg.		

~~NOTE: The three remaining pages apparently are part of a different project.~~

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TRANSFORMER 1 FE 311 - 111

Rated values:

	V	A	VA	cps
I				
II	fill in figures			
III				
IV				
V				

Insulation resistance against core and prim. winding at least 3×10^9 ohm.

Core and assembly: See FE 311, sheet 2.

Wind turns free, then insert into filling body, anchor with "Cohesan". Fill up layers. Wires DIN 6431, 6435.

In assembly, watch position of coil ends (primary ends on opposite side of secondary ends).

Winding	Ia	Ib	II	III	IV	V
Breakdown voltage						
Turns						
Indication						
Copper diam.						
Turns per layer						
Core, mm						
L (?)	fill in figures					
radius, mm						
Wire, grams						
Ends						

Testing: VA_o approx. 4.7, $W_o = 1.5 + 15\%$

U_p at 50 cps : 1.5 kV per 0.5 m

Each winding includes core and adjacent winding.

(84367 -11)

(84367-12 and 13:)

Anschlussbezeichnung der sekundaeren Loetoesenleiste: Connection symbols on the secondary soldering terminal strip

" " primaeren " :Connection symbols on the primary soldering terminal strip

Spulenfolge auf dem Kern: Sequency of coils on the core

Schrauben und Muttern lackgesichert: Screws and nuts protected by lacquer

Parts list:

no.	Name of item (read up)	Number of items	Drawing number	Surface number
1	Soldering terminal strip			
2	same			
3	Cylindrical-head screw			
4	Angle piece			
5	jack			
6	nut			
7	soldering jacks			
8	cylindrical-head screw			
9	cap			
10	cap			
11	wedge			
12	core sheet			
13	separating plate			
14	disk			
15	cylindrical-head screw			
16	base angle piece			
17	disk			
18	nuts			

(84367 -14)

(autotransformer ?)

Transformer 2 (~~in circuit to economize plate current~~)

Rated values: V A VA (Vbg(?)) cps

Core and assembly: Approximately 50 sheets M 65 III, 0.5 x0.5

El 1001 alternating circuit (?)

filling body EL 1035 with four soldering jacks

Assembly EL 1041, 1042

Turns to be wound over 2 x0.1 lacquered paper onto the filling body. Layers to be filled . Wires: DIN 6431, 6435. Insulation: Lacquered paper. Insert label into last insulation layer. Layer insulation 1 x 0.03.

Winding I

Breakdown voltage

Turns

Indication

Copper diameter

Turns per layer

L

Final insulation

radius

ends

wire

Lage der Loetoesen : Position of soldering jacks.

Testing: VA_o approx. 9, W_o = 2.9 + (illegible) percent, U_p at 50 cps 1.5 kV per 0.5 m